

contributes the following account. As its author appears to be habitually careful and painstaking in both observation and statement, the description is thought to be of value:

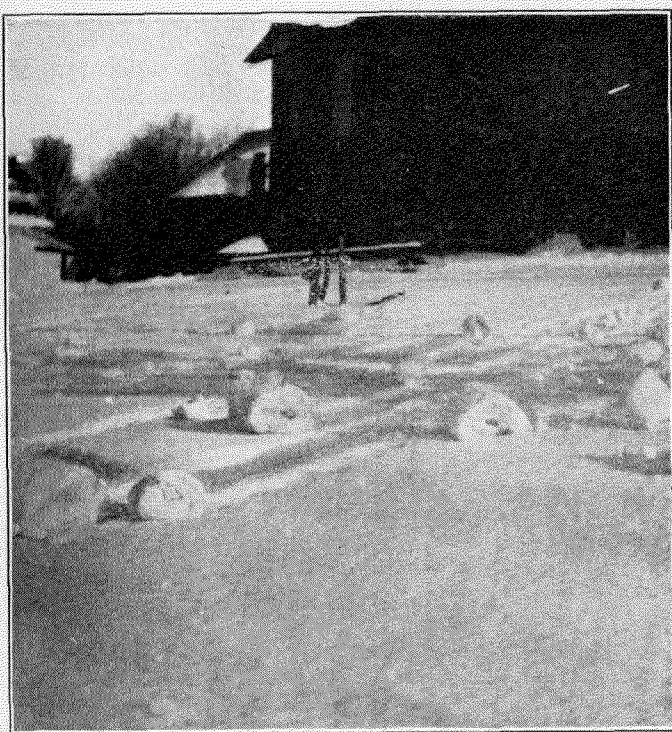


FIG. 1.—Snow rollers at Canton, N. Y., February 20, 1907.

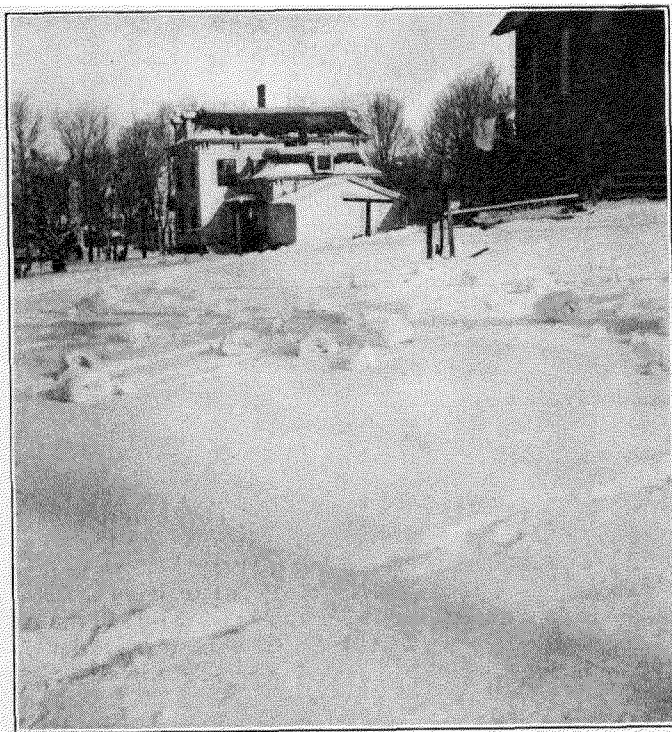


FIG. 2.—Snow rollers at Canton, N. Y., February 20, 1907.

During the winter of 1895 I watched the formation and progress of so-called snow rollers. The temperature was probably a trifle above the freezing point, following a snowstorm characterized by very large, light flakes. For the most part the wind seemed to sweep downward and get under a slightly projecting mass of snow and set it in motion. As the roll grew in size the speed, at first very rapid, slackened until the mass be-

came too compact and heavy to be moved farther. Sometimes a triangular shaped "card" of snow, often three or four inches across the base, would rise and fall several times before the wind gained sufficient purchase to turn the point over and start the roller. This card looked very much like the corner of a piece of paper as it rises and falls with the wind just before it is blown away. The snow seemed to be of an unusual consistency, rendering it tough and flexible.

These rollers were observed at Edenton, St. Lawrence County, N. Y.

E. SCHARF ON THE EFFECTS OF HAIL ON CROPS¹

Insurance against damage to growing crops by hail is practised quite extensively in Europe, chiefly by small local associations on the mutual plan. It is to aid in the adjustment of claims under this form of insurance that the present work appears to have been written.

The author begins by defining the three varieties of hail commonly recognized in his section of Germany, viz, "Graupel", the small, opaque, snowy hail of cold weather; "Schlossen", an intermediate form; and "Hagel", or true hail, the frequent accompaniment of summer thunderstorms. Well known facts regarding the distribution of hailstorms in space and time are also summarized.

The bulk of the work, however, is an original study, in great detail, of the effects of hail upon each of the ordinary field crops; these vary with the severity of the storm, with the stage of the crop's growth, and even with the character of the soil and the amount of fertilization, as influencing the vigor of the plants and their ability to withstand the blows of the hailstones. Numerous drawings and photographs make clear the characteristic effects of a hailstorm, and aid one to distinguish these effects from the ravages of wind, insects, and disease.

We believe this is the first treatise of its kind. It should be within the reach of anyone who is interested in hail insurance, whether as an underwriter or a policy holder.—C. F. T.

LONG-RANGE INDIAN MONSOON FORECASTS.

The annual publication by the director of the Meteorological Service of India of a statement of general atmospheric conditions, with an attempt to forecast the general character of the southwest monsoon rainfall, has now proceeded for about twenty years with a variable degree of success, but sufficient to show that the effort at long-range forecasting is really worth while. The work was begun by Blanford, was carried on by Sir John Eliot, and is now in the hands of his successor, Gilbert T. Walker. Pending a more extensive investigation into the philosophy of these seasonal forecasts we quote the following remarks from a review of the subject by Professor Hann, of Vienna, as published in the *Meteorologische Zeitschrift* for February, 1907.

Blanford thought that he had shown that generally snowfall in the regions to the north and west of India produced an abnormal distribution of pressure over northern India that was unfavorable to the advance of the southwest monsoons over this region; and he adopted the general principle that lower atmospheric pressure over any area increased the amount of its rainfall.

Sir John Eliot showed that the conditions over India alone would not suffice to justify reliable forecasts, and after the year 1894 information as to the conditions over the Indian Ocean was made use of, extending annually farther south, until, in 1897, even Africa and Australia were considered. It seemed most probable that heavier rainfall at Zanzibar and off the Seychelles in May would justify predicting heavier rainfall in India later in the season, when the monsoon has crossed over the equator. But later experience showed that the opposite was the case. Then it was assumed that perhaps an abnor-

¹ Scharf, Edmund. *Der Hagel. Erkennung, Beschreibung, Beurteilung und Schätzung von Hagelschäden.* Halle a. S.: Im Selbstverlage des Verfassers. 1906. vi, 195 p. 12°.

mal high pressure over Mauritius would increase the monsoon current and the Indian rainfall; but this did not prove to be the case. The relations between rainfall in India and atmospheric pressure over India, Siberia, the Indian Ocean, and South America are such that in years of excessive monsoon rainfall in India the atmospheric pressure over South America is too high, and conversely, small rainfall in India goes with low pressure in South America. Moreover in many years the low pressure occurs earlier in South America than the small rainfall in India. A table of snowfall for fifteen years shows that in the case of heavy and late snowfalls, when the area in the Indian highlands covered with snow in May is larger than usual, it argues for small rainfall in June.

Thirteen years of records show that heavy rainfall in the subequatorial region, over Zanzibar and the Seychelles, brings deficient rainfall in India over both branches of the monsoon; so that in general the snowfall in upper India is not connected primarily with the subsequent defect in rainfall, but is only an indication of a disturbance in the general circulation of the atmosphere. Moreover excessive rainfall at Zanzibar in April and May coincides with deficient height of the flood wave in the Nile River; so that we may say that a deficient snowfall in upper India coincides with a deficient flood in the Nile. On the other hand heavy snowfall in India and heavy rainfall in the equatorial region is paralleled by the connection between abnormal rainfall at Zanzibar and the Seychelles in November, with heavy snowfall in upper India in the subsequent cold season.

With regard to atmospheric pressure and rainfall high pressure in Mauritius means small rainfall in India, and low pressure in Mauritius is followed by heavy rainfall in India, in a large majority of cases, namely, 80 per cent. Comparing pressures in Argentina with rainfall in India, Walker and Hann are led to the remarkable result that positive departures of pressure in the spring at Cordoba are followed by positive departures of the next following summer rainfall in India. The worst drought in India, with a rainfall departure of -24 per cent, or 254 millimeters, was preceded by a departure of -1.4 millimeters of barometric pressure at Cordoba; whereas the best monsoon rainfall, 1892, with a departure of +124 millimeters, was preceded by +1.8 millimeters of pressure departure at Cordoba. According to the last memorandum by G. T. Walker, large departures of pressure in July at Mauritius have a close connection with the simultaneous opposite departures of rainfall in August and September over the whole of India.

In conclusion Hann says that the method by which Walker has carried out his investigation seems to be the most appropriate, namely, the comparison of the departures of the meteorological elements. We must know both the direction and the quantity of the departures. We must compare them geographically as well as chronologically. The best example of such work consists in Hann's study of the anomalies of the weather in Iceland as compared with those on the continent of Europe.

LONG-RANGE SEASONAL FORECASTS FOR SOUTH AFRICA.

Mr. D. E. Hutchins, conservator of forests for South Africa, read a paper before the South African Philosophical Society, at Cape Town, November 29, 1905, entitled "The cycle year 1905 and the coming season". An abstract, furnished by Mr. Hutchins, occupies pages 98-105 of the Agricultural Journal of the Cape of Good Hope for January, 1906, Volume 28, No. 1. The author has made an elaborate study of the rainfall data published regularly in the Agricultural Journal by Mr. Charles M. Stewart, Secretary to the Meteorological Commission of Cape Colony; and while his first thought has been to work out chronological cycles in South African rain, he has also lookt

for geographical relations, namely, the relations between the rains of South Africa and those of the states to the north of it, as well as of more distant countries. The first publication of Mr. Hutchins that we find mentioned is one of 1888, entitled "Cycles of Drought and Good Seasons in South Africa". For the present paper of November, 1905, he prepared diagrams of the rainfall records at Cape Town, Grahamstown, and Durban, which accord remarkably with the three cycles that he has worked out for Cape Colony weather. These cycles he designates as follows (see Table 1):

(1) The "solar cycle" of 11.11 years, whose maximum occurred in 1905, and which happened that year to agree with the maximum of sun spots, but does not always do so; three of these solar cycles, or the 35-year sun-spot cycle, he calls the "Brueckner cycle".

(2) A cycle of alternating periods of nine and ten years, or an average of nine and a half years; this he terms the "storm cycle"; its maximum will occur in 1907; it has its greatest influence on the winter rainfall of the western portion of South Africa, while in the eastern portion it is liable to bring only wind. This also corresponds to the mean period between successive droughts in Australia.

(3) A cycle with alternating periods of twelve and thirteen years, or an average period of twelve and a half years; this he terms the "Meldrum cycle", in compliment to that eminent meteorologist; this cycle brings a good deal of general rain, but usually especially affects the summer rainfall of the eastern districts of South Africa.

TABLE 1.—*Dates of cycles.*

Solar cycle, 11.11 years.	Brueckner cycle, 35 yrs.	Storm cycle, 9.5 years.	Meldrum cycle, 12.5 yrs.	Wolfer's sun-spot numbers.	
<i>Maxima.</i>	<i>Maxima.</i>	<i>Maxima.</i> 1813.0	<i>Maxima.</i>	<i>Maxima.</i>	<i>Minima.</i>
1816.62			1818.0	1816.4	
1827.73		1822.5			1823.3
		1832.0	1830.5	1829.9	1833.9
1838.84	1835.5			1837.2	
1849.95		1841.5	1843.0	1848.1	1843.5
		1851.0			1856.0
1861.06		1860.5	1855.5	1860.1	1867.2
		1869.5	1868.0	1870.6	
1872.17	1870.5				1878.9
1883.28		1879.0	1880.5	1883.9	1889.6
		1888.5			
1894.39		1893.0	1893.0	1894.1	
		1898.0			1902.0
1905.50	1905.5		1905.5	1905.5	
		1907.5			

These three cape weather cycles were recognized by Mr. Hutchins in 1888. By means of them the rainfall of that year was predicted, and he states that they have agreed with the rainfall of subsequent years, with but few failures. As we have not the rainfall data at hand we can only quote Mr. Hutchins's statement that, during the period 1841-1905 at Cape Town, the Meldrum cycle has failed once and been one year late three times. During the period 1865-1905 the storm cycle has failed three times out of four at eastern stations, and has sometimes been late; but at Grahamstown itself only one failure and one lateness have occurred. At Durban, however, the storm cycle has failed twice, and the rains came late five times during the period 1866-1905. After a detailed consideration of the rainfall for each year from 1865 to 1905, given on pages 104, 105, he states the following conclusions: (1) The three main weather cycles are of general application thruout South Africa, and the storm cycle and Meldrum cycle are of general application east and west beyond their areas of greatest influence. (2) As we go northward the heavier rainfall occurs